Space Weather Technical Forecast

Issued on Thursday, 14 July 2022 at 13:01 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 blackouts throughout, with a slight chance of R3 blackouts and S1. Chance of Active electron fluence later in period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with a single M-class flare and numerous C-class flares observed over the past 24 hours. There are presently six sunspot regions on the visible disc, four of which are large. AR3055 in the southwest remains the largest region but is magnetically simple. AR3057 in the northeast, is the next largest spot, but this appears to also be magnetically simple and has only produced minor flares. AR3053 is also rather large and has a delta configuration within its intermediate penumbra. AR3056 in the southeast, has increased in size and number of spots, but still remains relatively small and simple. There is a new region emerging from the northeast limb, which was the source of the M1.2 flare at 14/0432 UTC. There are also numerous large filaments on the visible disc, however there were no signs of instability in these in the reporting period, but will need to continue to be monitored. Therefore, no Earth-directed CMEs were observed in the available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been generally elevated, rising from around 500 km/s to 570km/s through the period. The density was largely average or a little above, with a maximum reading of 16 ppcc at 14/0149 UTC. The IMF was mostly weak but rose to moderate after 14/1035/UTC, with the north-south component varying +/-4 nT. The phi angle was largely positive (away from the Sun). These parameters would suggest that Earth is under the influence of a high speed stream, most likely from coronal hole 99. Corresponding geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, is at background levels. The high energy electron flux (greater than 2 MeV) remained at background levels. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold but on a gradual rising trend. The observed fluence at 14/0000 UTC was 4.33e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: Solar winds are expected to remain elevated on day 1 (14th) due to the HSS originating from CH99/+. Through days 2 and 3 (15th-16th) solar winds are forecast to ease towards ambient levels as coronal hole effects wane. No other enhancements are currently expected during the period. Geomagnetic activity is expected to initially be Quiet to Unsettled, with a chance of Active intervals. Predominantly Quiet geomagnetic activity is expected on days 3 and 4 (16th and 17th).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels. There is however a daily Slight Chance of S1 or greater event, due to the presence of 2 relatively large sunspot regions transiting across the western hemisphere.

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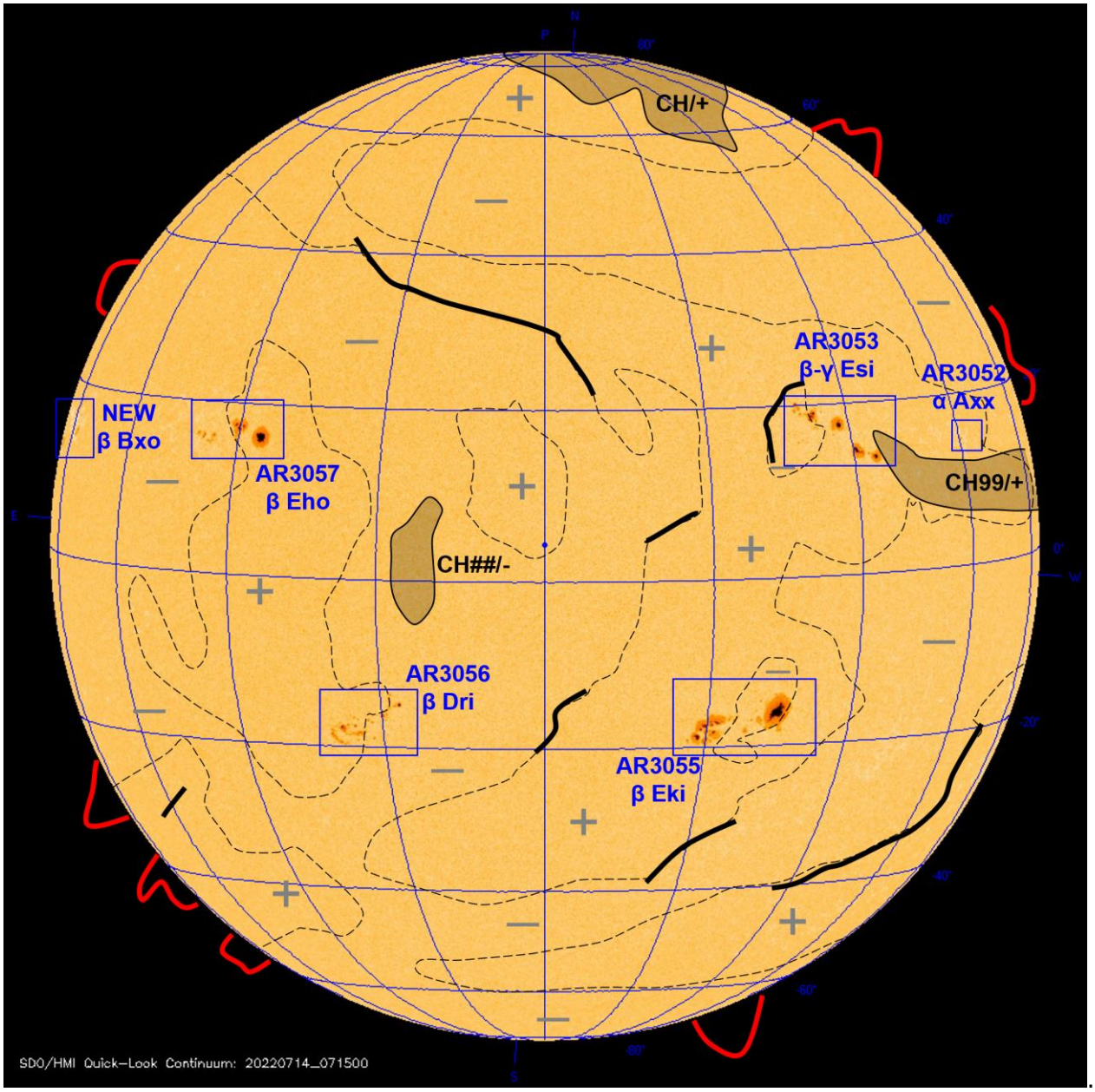
The high energy electron flux (greater than 2 MeV) is expected to increase over the coming days, with diurnal maxima possibly exceeding the High (1e3 pfu) threshold. Fluence levels are also expected to increase and there is a chance of them exceeding the Active (1e8 integrated pfu) threshold from day 3 (16th).

Figure 1. Solar Analysis Valid 14/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

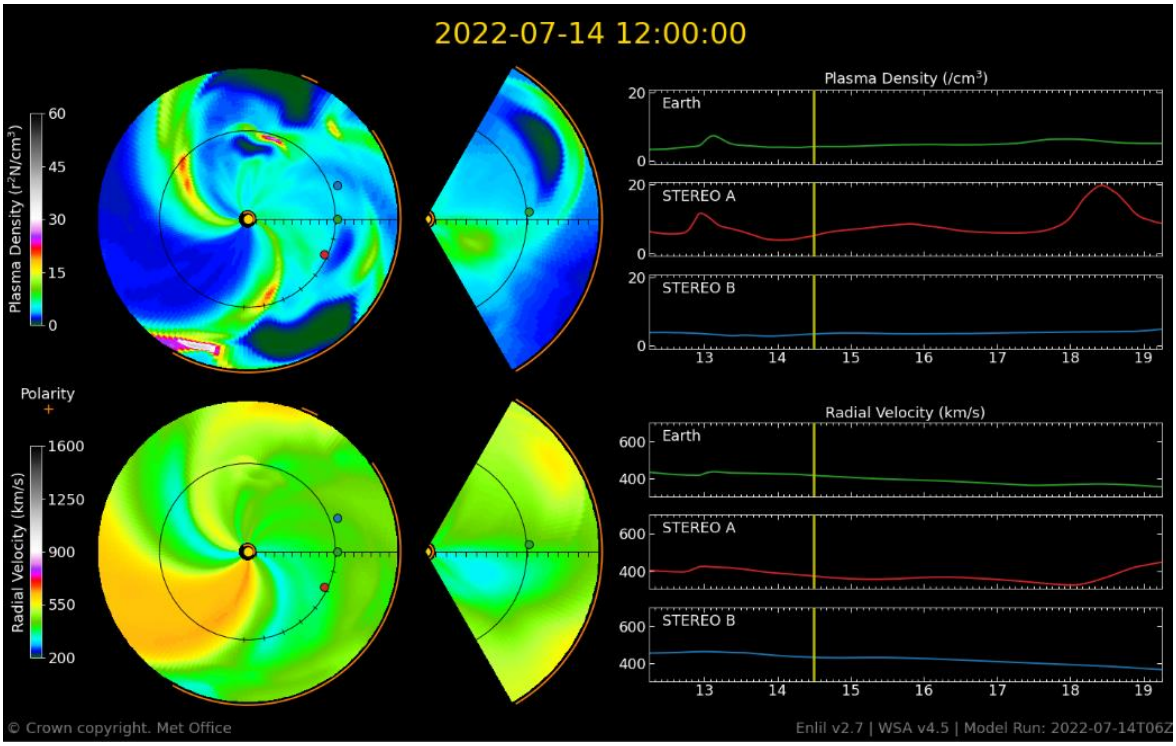
No CMEs feature in this forecast.

The solar wind is currently elevated and is expected to remain so through day 1 (14th), under the influence of the high speed stream originating from CH99/+. From day 2 (15th), the solar wind should begin to decline towards ambient levels, with no other enhancements currently expected during the period.

Geomagnetic activity is expected to initially be Quiet to Unsettled, with a chance of Active intervals and a slight chance of a G1 / Minor Storm interval if there are any prolonged periods of negative Bz whilst winds remain elevated. Predominantly Quiet geomagnetic activity is expected on days 3 and 4 (16th and 17th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



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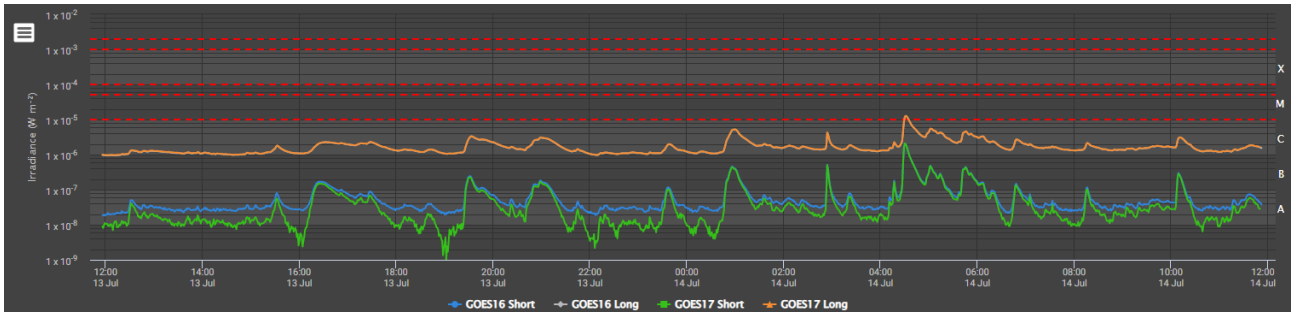
Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate in the last 24 hours, with a M1.2 flare during the early hours of 14th UTC. Further occasional M-class flares are considered likely, with a slight chance of an isolated X-flare. The most likely sources for this activity is either AR3053 in the northwest quadrant, AR3055 in the southwest quadrant, or the new region emerging in the northeast limb. This latter region was the source of the M-class flare in the past 24 hours and is likely to be larger and more complex than it's current classification suggests. Background flux is now comfortably within C-class territory.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: X-ray flax trace past 24 hours



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels. There is a slight chance of an S1 or greater, due to the presence of two large sunspot regions (AR3053 and AR3055) transiting across the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton trace past 24 hours

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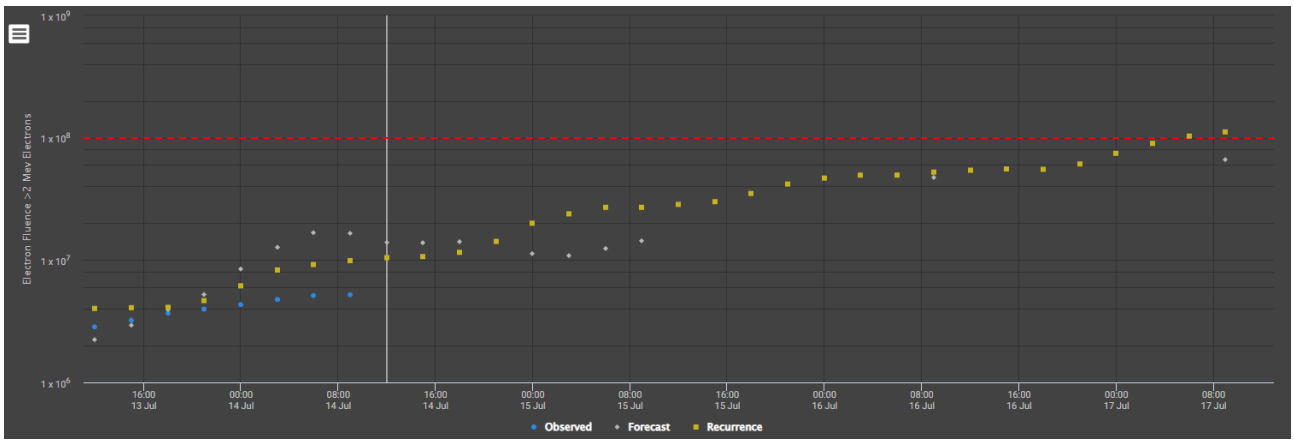
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently at background levels. The current elevated solar wind speeds is likely to cause some electron charging over the coming days, Electron Flux levels are forecast to increase over the next 4 days and it is possible that the 1e3 pfu Active threshold may be breached near the diurnal maximum on days 2-4 (15th-17th). Corresponding electron fluence levels are therefore also expected to rise over the coming days and there is a chance that they will exceed the Active (1e8 integrated pfu) threshold from day 3 (16th). However, it is currently thought that they will most likely stay just below this threshold, as presented by REFM and persistence data, which is considered to be providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	30	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: REFM showing predcted rise in fluence levels over coming days.



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